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Automated Analysis of Blood Pressure Measurements (Korotkov Sound)

The problem:

As part of medical studies on persons working in special environments, such as in manned space flight, automatic noninvasive measurements of arterial blood pressure may be required. The most common noninvasive method is to listen to the sounds (Korotkov sounds) of the expanding and contracting arteries and correlate these sounds with a corresponding arm cuff pressure. To automate this process, it is necessary to design an electronic circuit that can act as a substitute for the physician's analysis and interpretation of the sounds.

The solution:

An automated Korotkov sound processor uses logic ratios to identify the Korotkov sounds.

How it's done:

Figure 1 shows the connection from the subject to the sound processor, and Figure 2 shows the Korotkov sound processor and decision logic system. An arm cuff attached to the subject is rapidly inflated to a pressure sufficient to stop blood flow to the forearm and is then slowly depressurized. During the depressurizing portion of the arm cuff pressurization cycle, 10-to 100-Hz Korotkov sound signals are picked up by the microphone, amplified, and fed to the processor and decision logic system. The systolic (contraction of the heart) portion of the signal follows two parallel paths to the systolic comparator. Along one path the signal is filtered (17-26 Hz) and converted to an absolute value. Along the other path the peak absolute value of the unfiltered sound is selected. The filtered values are the numerators, while the simultaneous peak unfiltered values are the denominators of a series of systolic ratios. The first signal to produce a ratio that equals or exceeds 0.45 is identified by the comparator as the Korotkov sound associated with systole.

Next, the wide-band Korotkov signals pass through a diastolic filter (40 to 60 Hz). The filtered output is then processed to get a diastolic ratio. The numerators are the voltages for each instantaneous sound, while the

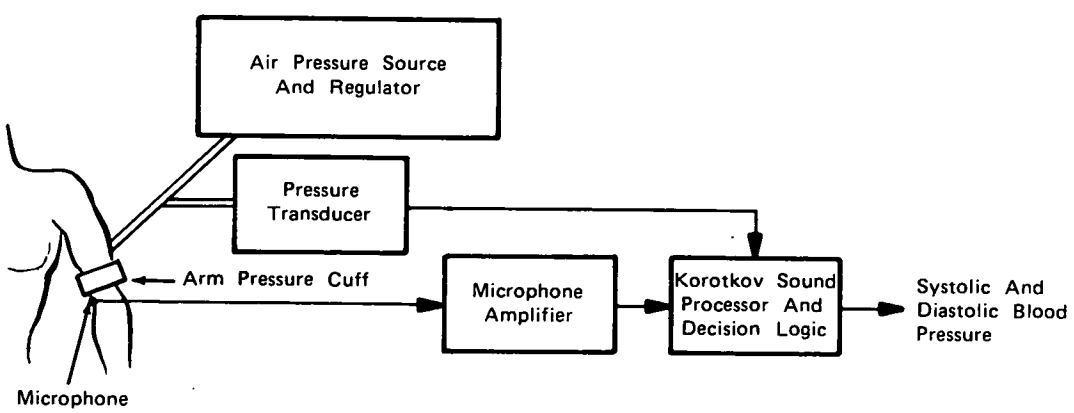

Figure 1. Subject Hookup, Automatic Korotkov Sound Processor

(continued overleaf)

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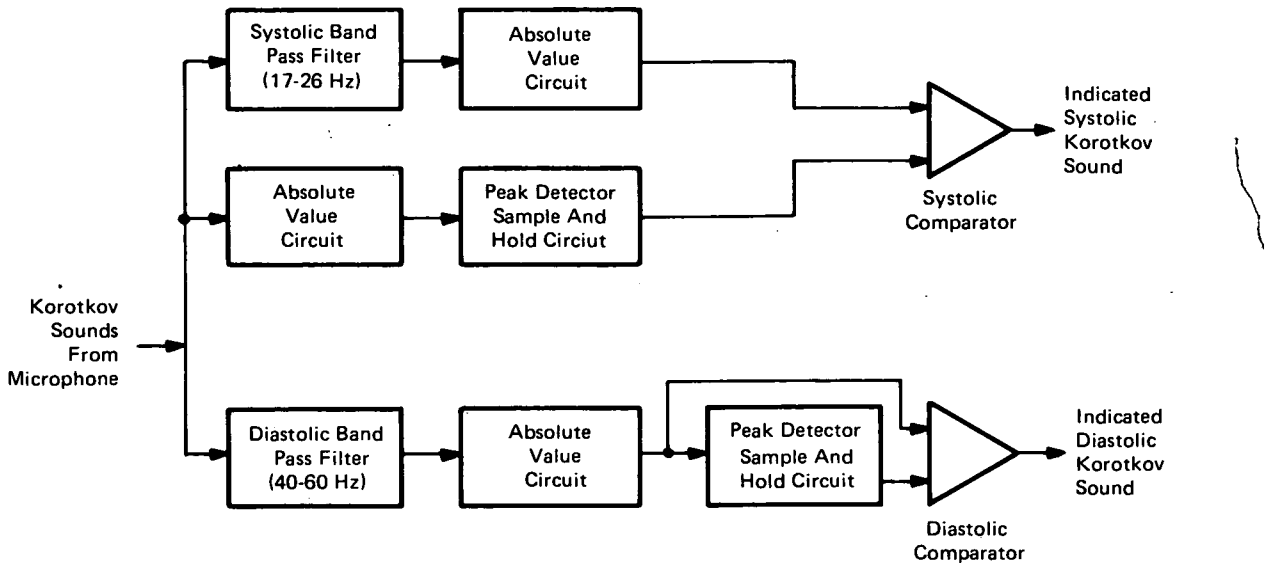

Figure 2. Sound Processor and Decision Logic

constant denominator for each pressurization cycle is the maximum value of the filtered output. The first ratio that falls below 0.17 is identified as the Korotkov sound associated with diastole.

The decision logic ratios provide an effective normalization of the amplitude variations of Korotkov sound signals obtained among a population of individuals. In addition, the system may be used with subjects resting or participating in a variety of activities.

Note:

Requests for further information may be directed to:

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Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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